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Play hard, Work harder.
Alternative reality game and scenario based assessments for learning.

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Abstract

In this paper, an evaluative case study is detailed as an example of alternative reality game and scenario based assessments for learning. This pedagogic approach is evaluated and recommendations for practice offered. Integrating technology into the assessment process, and final student product, influenced the chosen pedagogy. The use of technology permitted this assessment approach to be adopted for a medium sized (n=40) student cohort. The use of wikis, eportfolios and digital reflective diaries were central to creating a learning environment that centralised the student and allowed them to construct and create their knowledge through scaffolded alternative reality games and scenarios. Additionally peer feedback/feedforward and peer review devolved the responsibility of learning to the students allowing the academic to facilitate and scaffold learning activities that aligned to this alternate assessment strategy.

Keywords

Alternative reality game based learning, scenario based learning, dynamic problem based learning, assessments for learning.

1. Game and Scenario Based Learning.

In recent Horizon Reports (New Media Consortium, 2012 and 2014) game based learning (GBL) has been highlighted as a pedagogical approach suitable for mainstream adoption within in the short to medium term (i.e. 2-4 years). Currently, there is a massive market for mobile gaming, with devices such as Sonys *PSP* and Nintendos' *DS* decedents of the Nintendo *Gameboy* of the late 1980's. Console based gaming has also developed rapidly, with several companies offering high resolution, interactive and engaging games (Nintendo *Wii*, Sony *Playstation*, Microsoft *Xbox*; Prakash et al., 2011). However, is there a place for playing games in the serious worlds of education and training? Certainly there are a number of traits of gaming that would be advantageous to include in any teaching and learning environment; skills such as collaboration, problem solving, communication and critical thinking can all be fostered and enhanced through suitable game play. Oftentimes, these soft skills are difficult to incorporate into the curriculum and educators struggle to find effective and engaging ways to teach these skills (Pulko & Parikh, 2003).

Games, and the scenarios encompassing the gaming environment, are inherently engaging and interactive; the player must do something in order for the game to progress. In the area of STEM (Science, Technology, Engineering and Maths) games often time take the form of computer-based simulations. For example, in a virtual laboratory a student is free to experiment, and fail, in a safe environment. Students can investigate like true scientists and ask the most fundamental inquisitive question "*what if....*". This aligns to Klopfer and co-workers (2009) concept of the five freedoms of play; in this concept the person is free to fail, free to experiment, free to fashion identities, free to chose how much effort they put into play and free to interpret the play situation whichever way they want. Students can learn as they play with the different components of the simulation; for example, mixing chemicals together. The scientific rules can be explained and incorporated into virtual scenarios, akin to gaming levels, allowing the student to navigate their own way through virtual world. Additionally, in the virtual world full interactivity allows the student to investigate an experimental set-up that would not be otherwise feasible (safety concerns, cost, etc.). This could promote deeper understanding of real world scenario by visually representing what would happen if, for example, the experimental technique was carried out incorrectly. Learning in this way would allow students to engage with a lab environment in an alternative way; normally the use of incorrect laboratory technique is frowned upon. Students should be encouraged to think for themselves, to be imaginative and to problem solve; this is the pedagogical approach adopted by some countries, particularly in Scandinavia, which has lead to a more creative graduate (Lee, 2012).

GBL offers a potential way to stimulate this kind of creative, independent learning; however, significant barriers to GBL adoption exist, not merely parents and students who see gaming as a fun and not a potential learning opportunity. One of the central barriers to the widespread implementation of GBL is the persistence of current pedagogical styles. Additionally, the alignment of assessment to the method of learning can be problematic. Should the assessment be game based, or divorced from the game? In the latter, the concepts learned during play are assessed by external methods; publications in this area cite a number of options including mind-mapping (Coller and Scott, 2009) or informal assessment of shared participation in the game itself, and formal assessment of student reflection and the artefacts produced in the game (Hickey and Jameson, 2012). Other barriers to incorporation of GBL can be grouped into three main areas; *infrastructural* (for example, access to the correct hard/software, lack of technical support/familiarity with games), *organizational* (for example, a lack of a community of practice within which to seek guidance and support or not enough time to prepare effective game-based learning) and *pedagogical* (for example, alternative teaching models required and the new role of the lecturer; de Freitas, 2006).

This evaluative case study aims to enhance the use of game and scenario based learning by addressing these barriers. Here, an alternative reality, non-computer game-based scenario for learning is detailed and evaluated (Keegan, 2012). The use of a non-computer based system reduces the *infrastructural* barrier for implementation. The students themselves acted as a community of practice to support each other's learning and thus diminishes the *organizational* barrier for adoption. Additionally, the process and assessment of this case study is detailed, and this, combined with the integrated recommendations for practice, aims to address the *pedagogical* barriers.

2. Research Context and Pedagogy

Research Context

The final year of tertiary education often involves teaching small to medium sized classes on specialised and current topics. This pedagogical evaluative study focuses on a final year *Advanced Bioprocessing* module. This elective class comprised three honours degree courses (40 students in total) each specialising in different scientific areas; pharmaceuticals, biopharmaceuticals and food innovation. The module was delivered over 24 contact hours and a concurrent period of self-study (a minimum of 52 hours per semester) to supplement class time. In terms of assessment, the module descriptors defined that each class must be assessed based on class specific and specialised projects. Traditionally, assessment took the form of a written essay and a terminal written exam to fully assess the theoretical elements of the module. The pedagogical evaluative study described here replaced the traditional essay with an alternative reality game and scenario based assessment for learning within the assessment strategy; the effect(s) on student engagement and perceived learning of this modification were investigated.

The research described here focussed on a final year undergraduate cohort over the course of one semester (12 teaching weeks comprising 10 weeks for continual assessment). The cohort self-assigned themselves into permanent working student groups (four per group) to investigate, research and solve the alternative reality games and scenarios provided to them on a weekly basis by the facilitating academic. Throughout their alternative reality game and scenario based learning, the student groups built and developed a digital reflective record of their solutions to each weekly task. Upon module completion, all digital artefacts produced were showcased to peers and formed the basis of an assessed in-class discussion. The student's work was assessed as per the module assessment breakdown outlined in Table 2.1.

Assessment Component	Method of Assessment		Module Weighting (%)
ePortfolio	Continual	Group	21
Class based discussion	Continual	Group	3
Reflective Writing	Continual	Individual	6
Exam	Terminal	Individual	70

Table 2.1 – Module assessment component, method of assessment and associated weightings. The evaluative case study focussed on the continual assessment elements only.

Pedagogy of this study

The implementation of the game and scenario based learning took a scaffolded and structured approach. Initially groups of four students (n=10 in this study) self-assembled into permanent working teams that would brainstorm and research solutions to each of the weekly tasks (scenarios). Each student group was provided with the scenario in the form of a weekly memo and given a week to generate solutions (or suggested solutions). These memos formed part of the alternative reality in which the students were immersed. This alternative reality was one in which each student had recently been employed as part of a multidisciplinary team (the permanent student working group) within a new bioprocessing company, *Bioplus*. Each week a different *Bioplus* staff member contacted the students directly (via email) with the task/scenario for that week. The aim of each memo was to build the student working groups towards the development of a novel bioprocess and subsequent product unique to each group. The role of the academic was to portray these fictitious *Bioplus* staff members via the weekly memos and to facilitate the students as they attempted to solve the tasks both in class and on online via the class discussion wiki. A list of the weekly scenarios is provided in Table 2.2

Memo Number	Fictitious *Bioplus* Staff	Memo Content Descriptor
1	CEO	Form group + review current research areas
2	CEO	Prepare presentation on new target product

3	General Manager	Develop digital portfolio to document development
4	Production Manager	Prototype logistics for small scale production
5	Production Supervisor	Annotated review of process related publication
6	IP Officer	Market comparison and patent database review
7	Sales Manager	Science communication for product marketing
8	No Memo	Artefact Review and Group Based Discussion 1
9	No Memo	Artefact Review and Group Based Discussion 2
10	No Memo	Artefact Review and Group Based Discussion 3

Table 2.1 – Summary of the weekly activities and memos provided to each working group.

Each week during class contact time the academic circled the various working groups to discuss their progress with the latest memo, focussing mainly on the underpinning science and the providing the ‘bigger picture’ point of view. The academic was involved initially during the students brainstorming and group discussions; however as time progressed the academic involvement decreased dramatically as the students took ownership of their project. Once the student groups became comfortable with group based discussions of the scenarios presented to them, the academic facilitated deeper student learning by accommodating peer review sessions, termed ‘*speed reviewing*’. In these peer review sessions students circled the classroom and spoke to peers from another group describing their latest developments within their project concept for three minutes. The peers then provided feedback through the ‘*two stars and a wish approach*’. This is a feedback/feedforward approach based on the reviewer commenting on two things they like (the stars) and one idea they think would make the project better (the wish; Atkinson and Black, 2007). Each peer review took five minutes in total and then the students moved around the classroom to discuss their project with another classmate. At the end of each peer-review session, the permanent working groups reformed and the feedback/feedforward noted from their peers was analysed and carefully considered in terms of constructiveness and appropriateness. Incorporation of peer feedback formed an integral part of the student centred learning process.

In total, seven memos were delivered over the course of the ten week project; some memos were updated mid-week to add an element of dynamism and to be more reflective a real world work environment, similar to the Overton and Randles' *Dynamic PBL* approach (2013). Students were asked to keep a reflective diary (ungraded and not reviewed by the academic) during their project; the students used this as they completed their end of project reflective essay, which was uploaded to the Institutes virtual learning platform, *Blackboard*, for academic review.

Pedagogical Evaluation Methodology

Pedagogical evaluation followed best ethical practices, and conformed to the Institutes Research Ethics Guidelines. The data collected took several forms; an anonymous multiple choice questionnaire (n=40), an anonymous standard institute module review form (n=40), personal student reflections (n=40) and a personal reflective researcher diary (n=1). Personal student reflections were short essays (approximately 2,000 words) written by each student reflecting on their learning journey. The students were guided in the layout of this reflective essay; however, the content was not prescribed by the lecturer (Orland-Barak, 2005). All data were collected once the students had completed the module with the exception of the researcher reflective diary, which was recorded by the researcher on an on-going basis. The researcher reflective diary recorded 'informal' discussions with students, personal researcher observations and comments. Students were asked for verbal consent to allow the researcher to record an interesting or relevant point raised during an informal discussion. Qualitative data were coded using into several key themes and sub-themes based on researcher interpretation influenced by Strauss and Corbin's (1990) Method of Constant Comparison. Data saturation was observed, as per the qualitative coding method employed. Subsequent data triangulation was utilised to ensure only valid themes were investigated and that the examples and findings are based on feedback from as broad a student base as possible.

3. Pedagogical Evaluation Results

The data collected were classified into themes, below, and included positive and negative aspects of the student learning experience.

Responsibility

Students can struggle with the transition from second level learning, where many students are 'spoon-fed' information from their teacher based directly on the expected terminal examination topics, to a more student-centred approach in higher education with a focus on epistemological development, peer-discussion or constructive learning (Scharle and Szabo, 2000). This is a reoccurring problem in Irish Higher Education Institutes, in particular early year undergraduate students (Keane, 2011). However, it was refreshing to note that, in general, students in this evaluative case study took ownership of their group project and reflected on this by positively identifying aspects where they drove their project forward:

> "*I feel that I took the reins in this particular aspect of the project*".
>
> "*This assignment offered a lot of freedom, but with responsibility; it encouraged us to think outside the box, and to not rely on stagnant templates*"

Group based learning

In this evaluative case study, alternative reality game based learning and scenario-based learning were interwoven to achieve a 'real life' environment in a classroom setting. In order to fully mimic an authentic experience, the student cohort worked in diverse, but permanent, groups. Although often times met with student resistance, small group learning has been shown to achieve higher academic achievement, more favourable attitudes toward learning, and increased persistence through STEM courses (Springer, et al., 1999). In this evaluative case study, all groups worked well together and both intra- and inter-group support was evidenced throughout.

> *"Not only did every group express their ideas, I feel I was encouraged to be fully involved and to enjoy the Bioprocessing module in a new way compared to other modules I was studying".*

Self-directed group learning was central to the student groups becoming autonomous and, chiming with Problem Based Learning (PBL), the academic facilitated student learning through discussion and scaffolding learning activities (e.g. memos) that allowed students to independently deepen their understanding. The students developed key skills that aligned to those of PBL: flexible knowledge development, effective problem solving, self-directed learning, effective collaboration skills and intrinsic motivation (Hmelo-Silver, 2004).

> *"I really enjoyed the team meetings. Hearing other group members give their ideas, taking them in and giving my opinion was what I found to be the real highlight of the project".*

Industrially relevant learning

Gamification is not just collecting points or badges, achieving high scores or defeating the 'end of level baddie'; it is about engaging students both in class and outside class in activities that promote deep thinking, problem solving, taking on a challenge and solving it (or at least suggesting a solution). A key benefit to learning through games is the inherent kinship amongst the student group and the immediate feedback and support network within the class as students, immersed in an authentic scenario, set about their personal and group challenges (Kapp, 2012). '*Authentic*' and '*real life*' were cited in almost all the student reflections and this emerged as a major positive for this project as rated by the student cohort.

> *"I found the* [games and scenario] *project was a very effective way to learn; making presentations, discussing choices and having to back up points was very similar to my work placement. It's a very industry-style approach to learning and collaboration".*

Furthermore, many students realised the potential benefit of working through a real-life scenario, but within the safe learning environment of the classroom. As final year students, it also allowed the group to not only contextualise their learning for their future careers, but also to reconcile their previous years of study.

Personal Development

An unexpected theme that emerged during data analysis was the students' own perceived personal development. All reflective essays mentioned some aspect of personal development ranging from improved academic skills to identification of current personal limitations:

> *"I now realise that working as a group forced me to acknowledge one of my own (big) personal flaws; I am a control freak!"*

Students commented that the use of their group eportfolio as a digital record of their groups development, along with their personal reflective diary, allowed them to view their learning and development through a new, reflective lens. It provided them with a space to review their understanding and identify areas, both academic and personal, which required further attention.

Reflective Learning

Students in this evaluative case study cited many of the benefits of reflective writing that chime with O'Keefe and Donnelly's (2013) outline of the key elements of eportfolios encompassing reflective writing. Furthermore, many students noted a change in their writing style from descriptive to critically reflective. Combining group work and reflective writing aligns to Rivard and Straw's (2000) concept of combining oral and written communication to deepen scientific understanding; both elements targeting different aspects of learning and, when combined, resulted in enhanced understanding.

> *"This learning experience has affected me in a positive way. This was a self-learning assessment where there was no right or wrong answer. Upon reflection, I found this to be an exceptional way of learning as I was my own teacher, but if I needed help or guidance; the lecturer was there".*

4. Conclusions and Future Work

This evaluative case study highlights the possibility of using alternative reality game and scenario based assessments for learning to enhance student the learning experience. Students in this case study displayed enhanced responsibility for their own learning, developed personal and academic skills that they believed would be advantageous as they prepared to enter their professional careers. The technological requirements to implement this pedagogical approach are minimal; however, the use of technology, in the form of eportfolios and class discussion wikis, did allow the learning the take place both inside and outside the classroom. In following this approach the academic role changes from 'sage on the sage' to that of a facilitator and learning activity 'scaffolder'. In future iterations of this model, collaboration will be sought outside the faculty (e.g. marketing, design, engineering) to engage students in truly cross-discipline alternative reality and scenario based assessments for learning.

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